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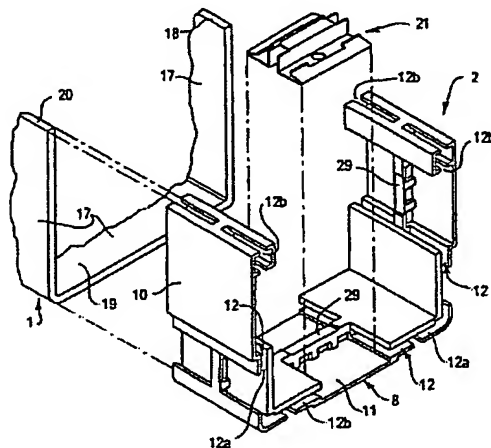
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(75) Inventor/Applicant (for US only): HOLLOWAY, Barry, Charles [AU/AU]; 5 Highlander Street, Torquay, VIC 3228 (AU).
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(54) Title: HOLLOW MEMBER CONNECTOR



(57) Abstract: A connector (2) for connecting hollow members (1) such as channel or tubular sections of a cable ducting system. The connector (2) has a shape substantially matching the cross-sectional shape of the members (1) to be connected, and includes at least one cavity (12) at each of two opposite ends. Each cavity (12) is adapted to receive part (17) of a respective one of the two members (1) to be connected. A locking element (21) is associated with each cavity (12) and intrudes into the respective cavity (12) so as to be engaged by a member (1) being inserted into the cavity (12). The locking element (21) has sufficient resiliency to deflect in response to engagement by the member (1), and to maintain pressure against a surface of the member (1) as the member moves over the locking element (21). The part (25) of the locking element engaged by the member (1) slopes in a direction such that it permits relatively free travel of the member (1) into the cavity (12) of the connector (2), but resists withdrawal of the member (1) from the cavity (12).

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HOLLOW MEMBER CONNECTOR**Field of the Invention**

This invention is concerned with the means whereby hollow members, such as separately formed lengths of channel or tube, are connected together.

- 5 The invention is particularly concerned with the means for connecting hollow members of the kind used in ducting systems to protect and/or guide cables, such as optical fibre cables. It will be convenient to hereinafter describe the invention with particular reference to cable ducting, but it is to be understood that the invention has wider application.

10 **Prior Art**

- A cable ducting system may include lengths of channel or tube connected end to end, or connected to any of a variety of hollow adaptors including elbow-pieces, T-pieces, cross-pieces, and size-change adaptors. Various methods are used to effect such connections, and one commonly practised method involves the use of a snap-lock connector. Such a connector has at least two deflectable detents, each of which is adapted to snap engage within an opening formed in a respective one of two hollow members to be joined.

- In a typical snap-lock arrangement of the foregoing kind, the detent receiving opening is a slot formed through a wall of the member to be connected at a position such that it can receive the detent of the connector. It is often necessary to form the slot on-site, and that adds significantly to the time required to complete the connection. Also, on-site formation of the slot makes it difficult to accurately position the slot and accurately form the slot to size. Inaccuracies in the position and/or size of the slot can seriously jeopardise the integrity of the connection. A failed or unstable connection can be particularly damaging in ducting systems for expensive and sensitive cable, such as fibre optics cable.

Summary of the Invention

- 30 It is an object of the present invention to provide an easy to use connector for hollow members. It is a particular object of the invention to provide such a connector which avoids, or at least minimises, the need for on-

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site modification of the members to be connected. It is a further object of the invention to provide an improved cable ducting system.

A connector according to the invention is characterised in that it has a locking cavity arranged to receive part of a member to be connected, and a
5 locking element arranged to intrude into the cavity so as to be engageable by the part of the member inserted into the cavity. When a member to be connected is being inserted into the cavity, the locking member deflects in response to engagement by that member so as to move away from an opposed surface of the cavity and thereby provide minimum resistance to
10 insertion of the member. The locking element remains in engagement with the inserted member, and responds to attempted relative movement of that member in a direction opposite to the direction of insertion by pressing more firmly against the member and thereby clamping the member against the aforementioned opposed surface of the cavity.

15 According to one embodiment of the invention, the one-way locking characteristic is achieved by means of an angularly disposed locking element which is able to swing or flex about one end (the pivot end) and has an exposed free edge at another end remote from the pivot end. The element slopes between the pivot end and the free edge so that the angle subtended
20 between the element and the median plane of the locking cavity is less than 90° . Furthermore, the direction of slope is such that the locking element presents a sloping ramp surface to a member being inserted into the cavity, and the element deflects as a result of the member engaging that ramp surface with the result that there is minimum resistance to continued insertion of the
25 member end of the cavity. In that regard, a member being inserted into the cavity is guided so as to be interposed between the locking element and an opposed surface of the cavity.

On the other hand, the sloping disposition of the locking element enables the element to impose significant resistance to withdrawal of the
30 inserted member from the cavity. That is achieved by the free edge of the element pressing against a surface of the member, and tending to bite into that surface in response to an attempt to move the member in a direction opposite

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to the direction of insertion. For that purpose, it is relevant that the part of the member engaged by the element free edge is interposed between that edge and the aforementioned opposed surface, and as a consequence is held against movement away from the free edge of the element.

5 It is a feature of the particular embodiment referred to above that the locking influence of the locking element increases in accordance with an increase in the withdrawal force applied to the inserted member. That arises because the reaction between the element and the member is such that the element attempts to swing in a direction such that the free edge of the element
10 is pressed more firmly against the member. As a consequence, the member is more firmly clamped against the opposed surface of the cavity.

In a preferred arrangement, the connector includes a body of plate-like form having a locking cavity in each of two opposite end edges, and each cavity is adapted to receive part of a respective one of two members to be
15 connected. It is further preferred that the locking element for each cavity forms a respective part of a one-piece clip attached to the connector body. The connector body may be formed of any suitable material, such as a plastics material. It is generally preferred to form the clip from a suitable metal such as spring steel, but other materials could be used.

20 According to one example, the connector body is of U-shape, and the base and each arm of the U is of plate-like form. A locking cavity is formed in the end edges of each arm and the base, and a separate locking element clip is provided for each arm and the base respectively. Other arrangements are clearly possible. By way of example, two or more clips could be interconnected
25 when formed, and could remain connected when attached to the connector body.

Description of the Drawings

Embodiments of the invention are described in detail in the following passages of the specification which refer to the accompanying drawings. The
30 drawings, however, are merely illustrative of how the invention might be put into effect, so that the specific form and arrangement of the various features as shown is not to be understood as limiting on the invention.

In the drawings:

Figure 1 is a diagrammatic perspective view of part of a ducting system incorporating an example connector according to the present invention.

Figures 2 to 5 each shows, in diagrammatic form, a section of a ducting
5 system incorporating connectors according to the present invention.

Figure 6 is a perspective view of the body of a connector according to one embodiment of the invention.

Figure 7 is a perspective view, shown on an enlarged scale, of a locking element for use with the connector body of Figure 6.

10 Figure 8 is a partial view of a connector body according to Figure 6, showing the relationship with a locking element according to Figure 7, and also showing part of a hollow member to which the connector is to be attached.

Figure 9 is a view similar to Figure 6 but showing two locking elements mounted on the connector body.

15 Figure 10 is a cross-sectional view, shown on an enlarged scale, taken along line A-A of Figure 9.

Figure 11 is an enlarged view of part only of the assembly shown in Figure 10, and showing a member inserted into the cavity of the connector.

Figure 12 is a view similar to Figure 11 and shows the member inserted
20 further into the cavity of the connector.

Figure 1 shows, in diagrammatic form, part of a cable ducting system in which two sections of channel 1 are connected end to end by means of a connector 2. In the particular arrangement shown, each section of channel 1 is of rectangular U-shape, but other shapes can be used. Also in the example
25 shown, each section of channel 1 has a hinged lid 3, which is shown in an open position in Figure 1. The lid 3 is closed after cables are positioned within the channel 1, and any suitable means may be adopted to releasably hold the lid 3 in the closed position. Other types of lids could be adopted.

The primary cable supporting members of a cable ducting system can
30 be in the form of tubes (of any suitable cross-sectional shape) rather than open-top channels as shown by Figure 1. The present invention is equally applicable to such a tube-based system.

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Cable ducting systems can be complex. It is therefore common practice to provide adaptors which enable variations such as a change in direction, branching of the system, or a change in the cross-sectional size or shape of the ducting, by way of example only. Figures 2 to 5 illustrate, in diagrammatic form, example variations of that kind, and show the use of connectors 2 which can be of the same form as the connector 2 shown by Figure 1.

In the Figure 2 arrangement, two separate sections of channel or tube 1 are connected to respective opposite ends of an elbow-piece 4 through connectors 2. In the Figure 3 arrangement, three separate sections of channel or tube 1 are connected to respective ends of a T-piece 5, and again connectors 2 are used to effect each connection. The Figure 4 arrangement is similar to the Figure 3 arrangement, except that a cross-piece 6 is involved rather than a T-piece 5. In the Figure 5 arrangement, two sections of channel or tube 1 of different cross-sectional size are interconnected through a change of size adaptor 7, and again connectors 2 are used to effect the connections.

Figure 6 shows the body 8 of one form of connector 2 according to an example embodiment of the present invention. That example is intended for use with U-shape channel ducting of the general kind referred to above in connection with Figure 1. It will be appreciated that the body 8 will be formed differently to that shown in Figure 6 if it is intended to be used with tubular ducting, or channel ducting of cross-sectional shape different to that shown by Figure 1.

The connector body 8 of Figure 6 is generally of U-shape, and each of the arms 9 and 10, and the base 11, is of plate-like form. A locking cavity 12 is formed in each of the two opposite end edges 13 and 14 of the base 11, and also in each of the two opposite end edges 15 and 16 of each arm 9 and 10. In the arrangement shown, each cavity 12 is in the form of a slot divided into two spaced parts 12a and 12b, but a single uninterrupted slot could be used in other arrangements.

Each cavity or slot 12 at the same end of the body 8 is dimensioned to slidably receive an end portion 17 of a respective one of the three walls 18, 19 and 20 of a ducting channel 1 (Figure 8), or corresponding portions of an

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adaptor as referred to in connection with Figures 2 to 5. For the purpose of the following description of the connector 2, it will be assumed that the members to be connected are channels 1 of the general kind shown by Figure 1.

Figure 7 shows one form of locking clip 21 suitable for use with the connector body 8 of Figure 6, but which is shown on an enlarged scale by comparison with Figure 6. The clip 21 shown by Figure 7 is in fact a double-ended clip, because it is operable at each of two opposite ends of the body 8 as hereinafter described. Three clips 21 are intended to be used with the body 8 of Figure 6. One clip 21 is attached to the base 11, and another is attached to each of the arms 9 and 10.

In the particular arrangement shown, the clip 21 includes a body 22 and two gripping plates 23 arranged at respective opposite ends of the body 22. Each gripping plate 23 is attached to the respective end of the body 22 through a hinge-like portion 24, and extends inwardly of the body 22 towards the other plate 23. As shown by Figures 7 and 10, each plate 23 slopes upwardly from the underlying surface of the body 22, and the direction of that slope is away from the respective hinge-like portion 24. The purpose of that sloping disposition will be hereinafter made clear. Also, it is preferred that the free outer edge of each plate 23 is turned upwardly to form a lip 25 which functions as hereinafter described.

It is preferred, as shown, that a recess 26 is formed in the outer edge of each plate 23 so as to provide a separation between two sections 27 of the plate 23, each of which carries a respective part of the lip 25. That separation between the two sections 27 of the plate 23 enables those sections to flex relative to one another and thereby assist in achieving a firm gripping action as hereinafter explained.

The clip 21 can be attached to an appropriate part of the body 8 in any suitable fashion. In the arrangement shown, the clip 21 has a channel 28 formed substantially midway between the plates 23, and that channel 28 is adapted to neatly receive a mounting rib 29 of the connector body 8. It is preferred that the channel 28 is a friction fit on the rib 29 so as to resist separation of the clip 21 from the body 8.

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Figure 8 is an exploded view of part only of the connector 2 showing the relationship between a clip 21 and an arm 10 of the body 8. Figure 9 shows one clip 21 mounted on an arm 10, and another clip 21 mounted on the base 11.

5 Figure 10 is an enlarged cross-sectional view showing a clip 21 in position on the body 8, and illustrates the purpose of the sloping disposition of the clip plates 23. Because of that disposition, each plate 23 intrudes into the space defined by a respective one of the slots 12, and is thereby positioned to be engaged by the end portion 17 of a channel member 1 inserted into the slot
10 12. Because of that engagement, the plate 23 is deflected away from an opposed surface 30 of the slot 12 as shown by Figures 11 and 12. Also, the angular disposition of the plate 23 is such that it provides minimum resistance to insertion of a member 1 in the direction of arrow 31 (Figure 11).

It will be apparent from Figure 10 that each of the slots 12 is adapted to
15 receive part 17 of a respective one of two members 1 intended to be connected together. The double-ended nature of the clip 21 enables that clip to impose its locking influence on each of the two members 1. In other arrangements, a separate clip might be provided for each of the two members 1.

20 If there is an attempt to remove the member 1 from the slot 12 by moving it in the direction of arrow 32 (Figure 12), the plate 23 reacts with the member 1 so as to create substantial resistance to withdrawal of the member 1. In that regard, the direction indicated by the arrow 32 is opposite to the direction shown by arrow 31. Referring in particular to Figure 12, a force
25 applied to the member 1 in the direction of arrow 32 places the plate 23 under compression because of a reactive force R acting between the member 1 and the plate lip 25. That is due (at least in part) to the angular disposition of the plate 23, and the consequent tendency of the lip 25 to bite into the surface of the member 1 with which it engages. The end result is a tendency for the plate
30 23 to swing in the direction of arrow 33 about the axis of the hinge-like portion 24. Resistance to withdrawal of the member 1 from the slot 12 is thereby increased, and that resistance will increase further with any increase in the

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withdrawal force in the direction of arrow 32. The member 1 is thereby firmly clamped between the plate 21 and the surface 30 of the body 8.

It will be understood from the foregoing that the connector 2 is self-locking, and locks in one direction only. Also, the connector 2 is able to lock
5 against a planar surface without the need for specially formed openings as are required to enable operation of prior art connectors.

The connector 2 shown in the drawings and particularly described, utilises three clips 21, but a larger or smaller number of clips could be adopted in other arrangements. The number of clips required, or considered to be
10 desirable, for a particular connector, will depend upon factors such as the size of the connector and the cross-sectional shape of the members to be connected.

Various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without
15 departing from the spirit or ambit of the invention as defined in the appended claims.

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CLAIMS

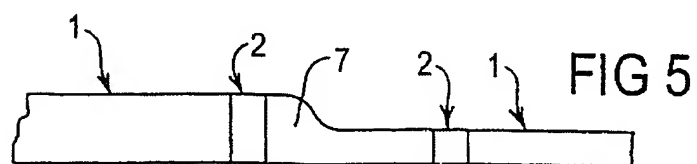
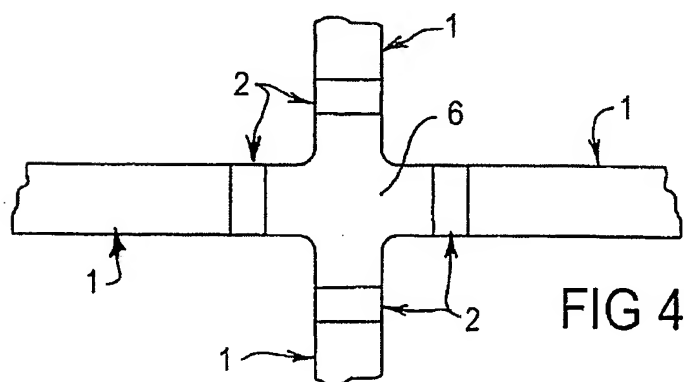
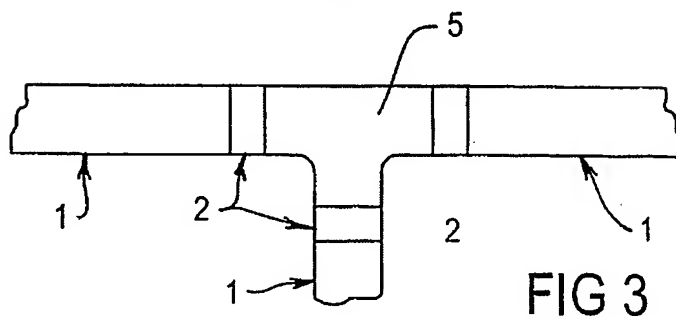
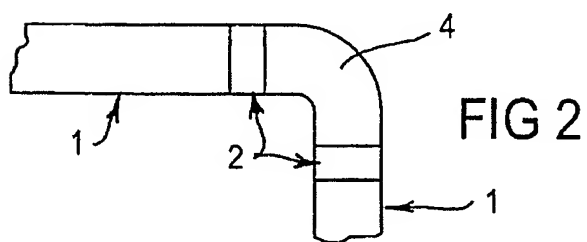
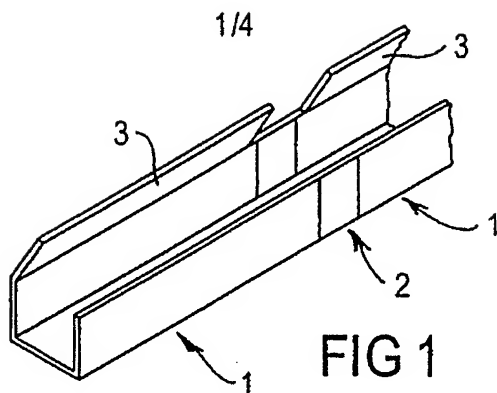
1. A connector for connecting one hollow member to another hollow member, the connector including a cavity for receiving at least part of a wall of said one member, said cavity having an open mouth through which said wall part is moved into and out of said cavity, and two opposed surfaces between which said wall part is received when located in said cavity, a locking element projecting beyond a first one of said surfaces towards a second one of said surfaces so as to intrude into said cavity and be positioned for engagement by said wall part as that wall part is moved into said cavity, said locking element
5 undergoing resilient deflection in response to said engagement so as to thereby enable the wall part to move across said locking element, said resilient deflection causing said locking element to maintain contact with said wall part when that wall part is inserted into said cavity and said locking element responding to attempted movement of said wall part out of said cavity by
10 imposing a force on the wall part so as to clamp that wall part against said second surface and thereby resist removal of said wall part from said cavity.
2. A connector according to claim 1, wherein a gripping plate of said locking element intrudes into the cavity, an outer edge of said gripping plate is located in said cavity and extends substantially parallel to a plane containing
15 said open mouth, and at least an outer portion of said gripping plate slopes towards said second surface in a direction away from said open mouth.
3. A connector according to claim 2, wherein said gripping plate extends across a substantial part of the width of said cavity.
4. A connector according to claim 2 or 3, wherein said outer edge is an
20 edge of a lip of said gripping plate, and said lip is angularly disposed relative to an adjacent part of said gripping plate so as to slope towards said second surface at an angle greater than the angle of slope of said adjacent part.
5. A connector according to any one of claims 2 to 4, wherein a recess is formed in said outer edge and separates two sections of said gripping plate,
25 the separation between said plate sections enabling each of those sections to flex relative to the other for the purpose of clamping said wall part.

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6. A connector according to any one of claims 2 to 5, wherein said gripping plate is connected to another part of said locking element through a hinge portion that is integral with both said gripping plate and said locking element body.
- 5 7. A connector according to any one of claims 1 to 6, wherein said connector includes a main body, said cavity is formed in said main body, and said locking element is attached to said main body.
8. A connector according to any one of claim 7, wherein a said cavity is provided at each of two opposite ends of said main body, each said cavity is adapted to receive a said wall part of a respective one of said members, and a
10 respective one of two said locking elements intrudes into each said cavity.
9. A connector according to claim 8, wherein the two said locking elements are interconnected.
10. A connector according to claim 9, wherein the interconnection between
15 said locking elements is formed by a mounting section through which said locking elements are attached to said main body.
11. A connector according to claim 10, wherein said main body includes a rib positioned between the two said cavities, and said mounting section includes a channel that neatly receives said rib.
- 20 12. A connector according to any one of claims 7 to 11, wherein said main body is of generally U-shape formed by a plate-like base and two plate-like arms, each said arm extending upwardly from a respective one of two opposite sides of said base.
13. A connector according to claim 12, wherein at least one said cavity is
25 formed in said base, and at least one further said cavity is formed in each of said arms.
14. A connector according to claim 13, wherein a said cavity is formed in each of two opposite ends of said base, and a said cavity is formed in each of two opposite ends of each said arm.
- 30 15. A connector according to claim 13 or 14, including a number of said locking elements, and wherein a respective one of said locking elements intrudes into each said cavity.

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16. An assembly including a connector according to any one of claims 1 to 15, and two said members interconnected by means of said connector.
17. An assembly according to claim 16, wherein at least one of said members is a tubular member.
- 5 18. An assembly according to claim 16, wherein at least one of said members is a channel member.
19. An assembly according to any one of claims 16 to 18, wherein at least one of said members forms part of a cable ducting system.
20. An assembly according to claim 19, wherein said connector includes a
10 passage through which cable can pass from one of said members to the other said member.



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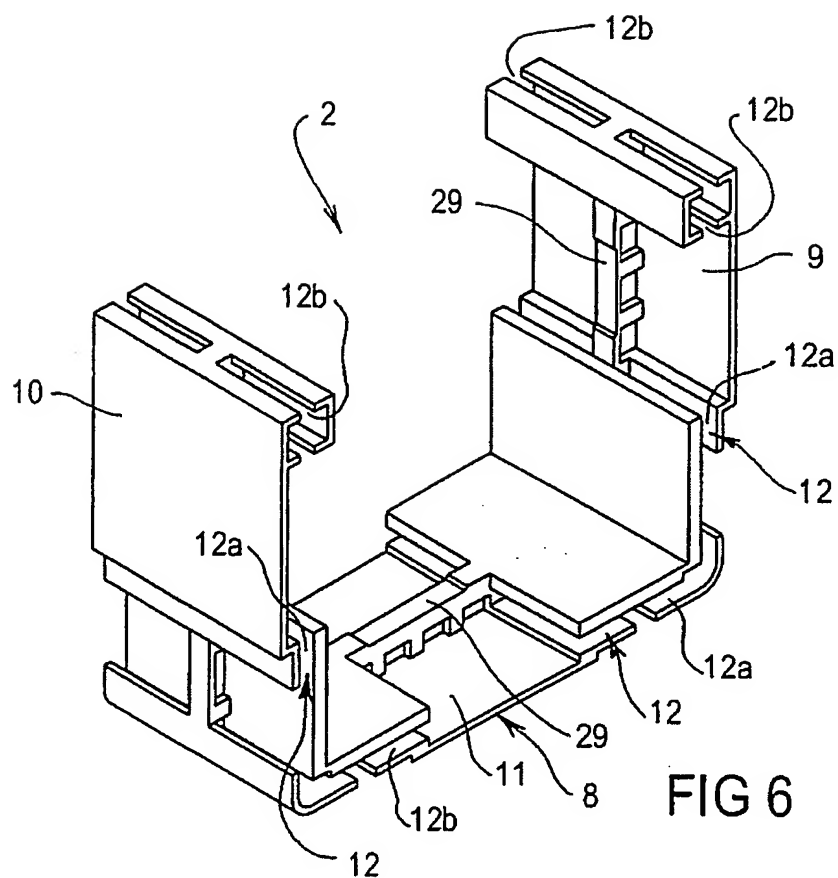
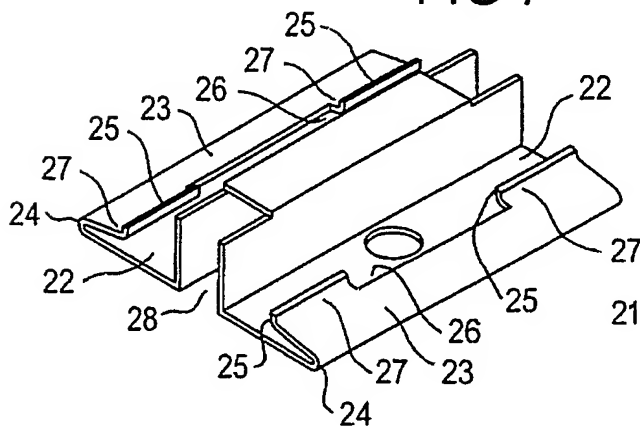


FIG 7



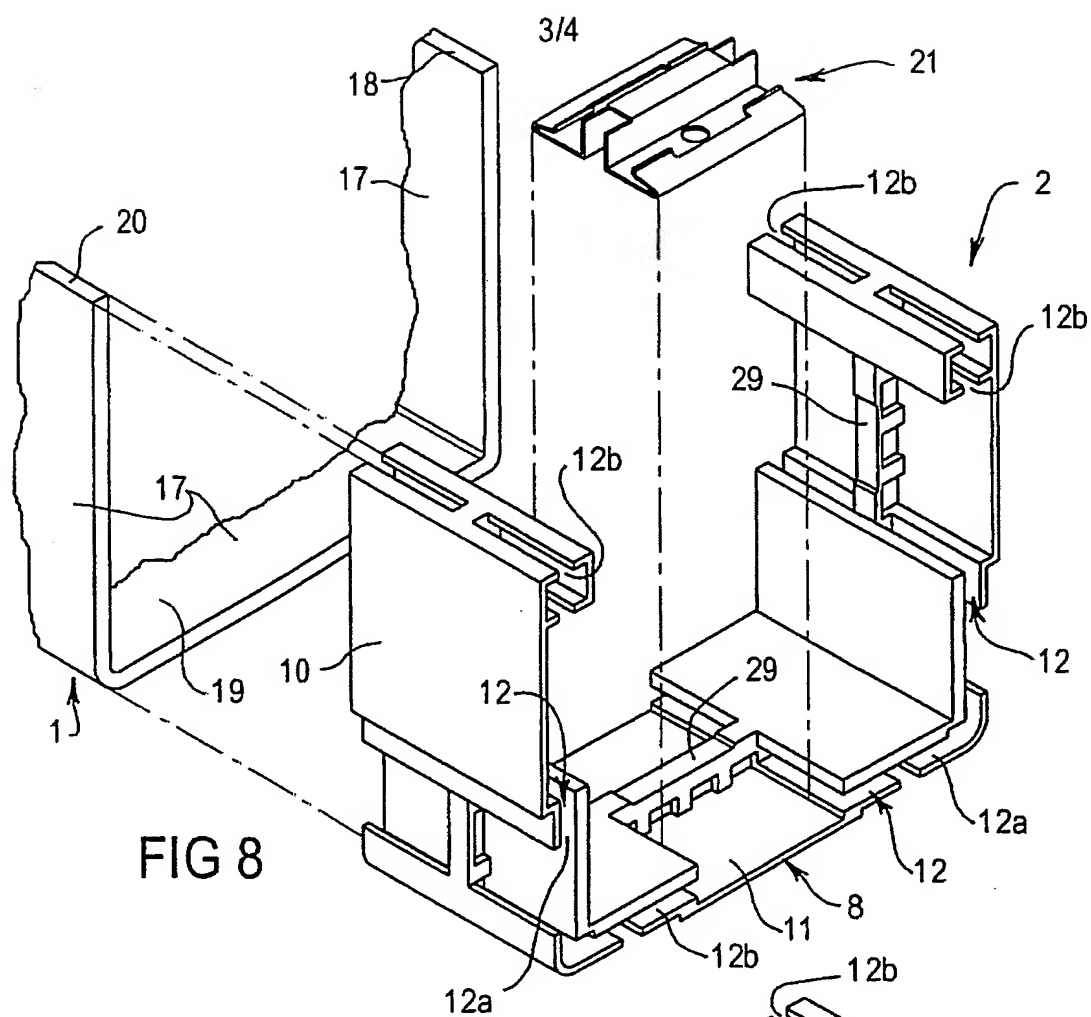


FIG 8

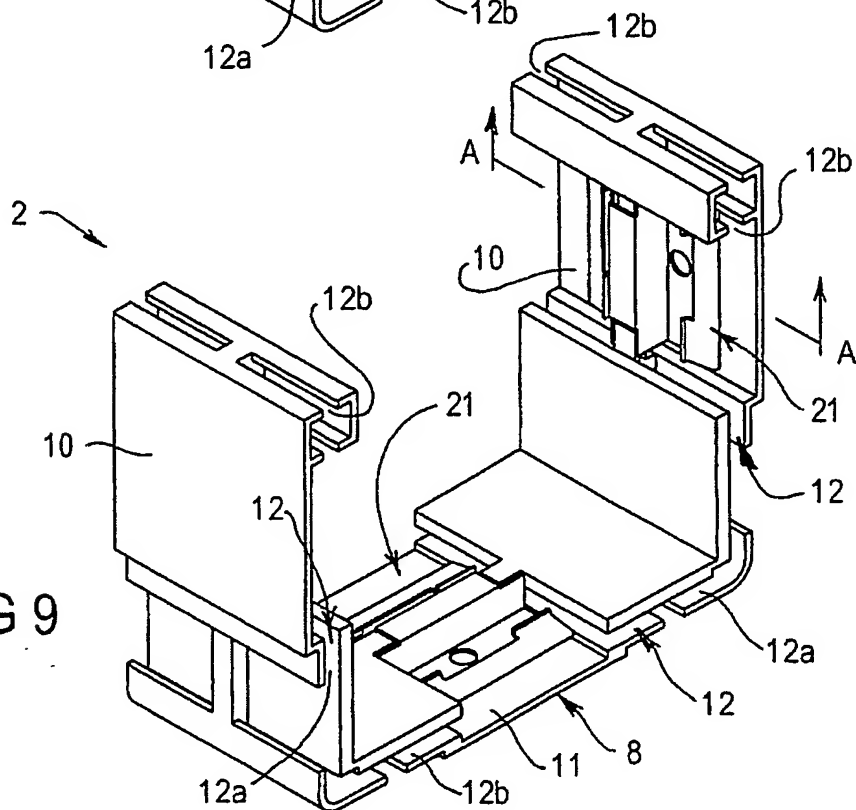
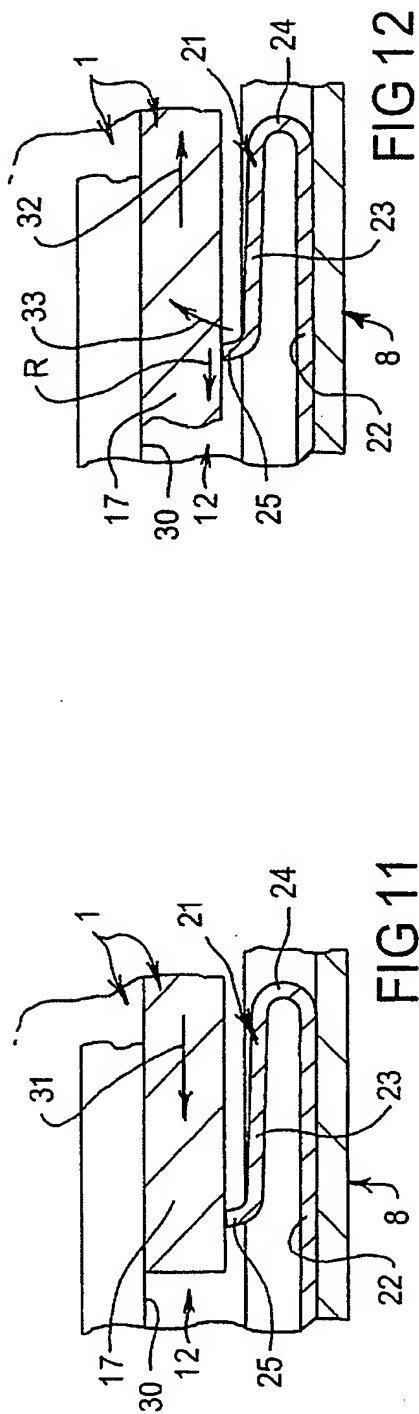
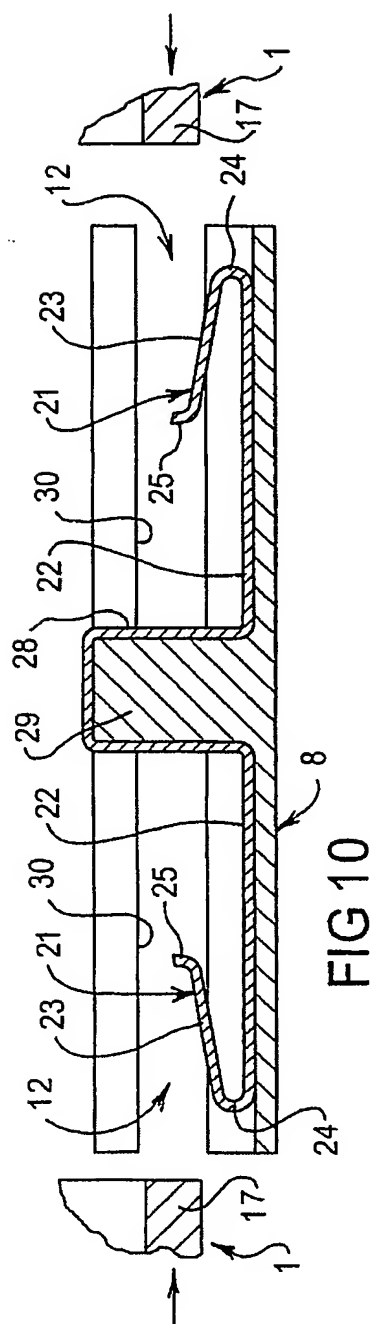


FIG 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 00/00497

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl⁷: F16L 25/00, F16B 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC F16B 7/00, 7/04, 2/04, F16L 19/00, 21/08, 23/14, 25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4146254 A, (TURNER ET AL) 27 MARCH 1979 see entire document	
A	AU 45459/89 A, (HAWKER DE HAULLAND LIMITED) 31 MAY 1990 see entire document	
A	AU 16671/76 A, (PHILMAC PTY LTD) 16 FEBRUARY 1978 see entire specification	

☒ Further documents are listed in the
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* Special categories of cited documents:	
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search
10 July 2000

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 00/00497

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 691520 A, (GIAT INDUSTRIES) 10 JANURARY 1996 see entire specification	
A	EP 203887 A, (PABRECO S.A) 3 DECEMBER 1986 see entire specification	

Information on patent family members

PCT/AU 00/00497

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
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		CA	1057791	DK	140677	HK	64280
		IL	51675	JP	52120417	MX	143856
		SE	7703599	ZA	7701930	US	4146254
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